



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 4732.4-2024

**Pressure vessels design by analysis - Part 4: Stress
classification method**

压力容器分析设计 第4部分：应力分类法

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part

1. Structure and drafting rules for standardization documents" Drafting. This document is Part 4 of GB/T 4732 "Analysis and Design of Pressure Vessels". GB/T 4732 has been published in the following parts.

1. General requirements;

3. Formula method;

4. Stress classification method;

5. Elastic-plastic analysis methods;

6. Manufacturing, inspection and acceptance. Please note that some of the contents of this document may involve patents. The issuing organization of this document does not assume the responsibility for identifying patents. This document is proposed and coordinated by the National Technical Committee for Standardization of Boilers and Pressure Vessels (SAC/TC262). This document was drafted by: Sinopec Engineering Construction Co., Ltd., Tsinghua University, China Huanqiu Engineering Co., Ltd. Beijing Branch, China Tianchen Engineering Co., Ltd., China Special Equipment Testing and Research Institute, Tianhua Chemical Machinery and Automation Research and Design Institute Co., Ltd., Shanghai Institute of Technology University, Hefei General Machinery Research Institute Co., Ltd. The main drafters of this document are. Huang Yongli, Lu Mingwan, Xiang Zhihai, Liu Yinghua, Zhang Yingkai, Xu Ruyong, Qu Jianping, Yang Guoyi, Chen Zhiwei, Duan Rui, Yuan Shaoyun, Li Jinke, Shen Yun, Wang Bing.

GB/T 4732 "Analysis and Design of Pressure Vessels" provides the requirements for the construction of pressure vessels according to the analysis and design method. GB/T 150 is

based on The rule design concept puts forward the requirements for the construction of pressure vessels. Pressure vessel design and manufacturing units can choose two construction methods according to the specific design conditions. One of the standards implements the construction of pressure vessels. GB/T 4732 consists of 6 parts.

1.General requirements. The purpose is to provide general requirements for pressure vessels built according to analysis and design, including relevant management requirements. Requirements, common terms and definitions, and basic requirements shared by other parts of GB/T 4732.

2.Materials. The purpose is to give the relevant requirements and material properties of steel materials in pressure vessels built according to analysis and design. Energy data, etc.

3.Formula method. The purpose is to give typical pressure components and structural design requirements of pressure vessels built according to analytical design. The thickness calculation formulas for commonly used container parts designed by the formula method are specifically given. GB/T 4732.3 can be used as The design basis of GB/T 4732.4 and GB/T 4732.5 can also be simplified and completed according to GB/T 4732.3. Analysis design.

4.Stress classification method. The purpose is to give the stress classification method used in pressure vessels built according to analysis and design. Design related regulations.

5.Elastic-plastic analysis method. The purpose is to give the elastic-plastic analysis method used in pressure vessels built according to analytical design. Relevant provisions for design in accordance with the law.

6.Manufacturing, inspection and acceptance. The purpose is to give the structural types of pressure vessels built according to analysis and design. Manufacturing, inspection and acceptance requirements for devices. GB/T 4732 includes the pressure vessel construction process based on the analysis and design method (i.e. materials, design, manufacturing, inspection, testing and verification). GB/T 4732 does not need to and cannot cover all the technical requirements and special prohibition regulations that need to be followed in the collection work. All technical details of the pressure vessel construction, therefore, under the premise of meeting the basic safety requirements specified in the safety technical specifications, there is no restriction There is no special mention of technical content in GB/T 4732.GB/T 4732 cannot be used as a technical manual for the construction of specific pressure vessels, nor can it be used as a technical manual for the construction of specific pressure vessels. Alternative training, engineering experience and engineering evaluation. An engineering evaluation is a review of a specific Technical evaluation of products. Engineering evaluation needs to comply with the relevant technical requirements of GB/T 4732. GB/T 4732 does not restrict the use of other advanced technical methods in actual engineering construction, but engineering and technical personnel use advanced technical methods. Reliable judgment is needed when applying the law to ensure that it meets the

requirements of GB/T 4732. GB/T 4732 neither requires nor restricts designers to use computer programs to analyze and design pressure vessels, but the use of computers is When analyzing and designing the program, in addition to meeting the requirements of GB/T 4732, it is also necessary to confirm.

1 Scope

GB/T 4732.4-2024 specifies the stress classification method, the classical route of design by analysis: an elastic stress analysis is performed, the resulting stresses are sorted into primary, secondary and peak categories, and each category is checked against a limit derived from plastic failure criteria. The method is used to guard against four failure modes, plastic collapse, excessive local strain, ratcheting and fatigue, and this part sets out the stress analysis, the classification itself, which is the step where engineering judgement most often goes wrong, the design evaluation against each criterion, and the other requirements. Normative annexes cover experimental stress analysis and further evaluation material; informative annexes cover the construction of loading histograms and cycle counting for fatigue evaluation and the linearisation of elastic nominal stress. The part states its own limits candidly: it applies to thin-walled plates and shells, or structures dominated by them, that remain generally elastic, and it warns that applying stress classification to thick-walled structures, cylinders with a radius to thickness ratio of four or less, can give uncertain results, in which case the elastic-plastic analysis of GB/T 4732.5 should be used instead.

This document specifies a stress classification design method based on elastic stress analysis and plastic failure criteria to prevent plastic failure of the container. Collapse failure, local overstrain failure, ratcheting failure and fatigue failure. This document is applicable to thin-walled plates and shells that are in elastic state or partially enter plastic state but are still in elastic state as a whole, or pressure-bearing structures with thin-walled plates and shells as the main body. Structure. For thick-walled structures (such as cylinders with $R/\delta \leq 4$), the use of stress classification methods may produce uncertain results. The analytical method in GB/T 4732.5. NOTE Unless otherwise specified, this document applies only to design temperatures below those at which the allowable stress is governed by the creep limit or rupture strength of the material.

2 Normative references

The contents of the following documents constitute essential clauses of this document through normative references in this document. For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document.

GB/T 4732.1-2024 Analysis and design of pressure vessels Part

3 Formula method

GB/T 4732.5 Analysis and design of pressure vessels Part

3.1 Terms and Definitions The terms and definitions defined in

GB/T 4732.1-2024 and the following apply to this document.

3.1.1 Loading histogram loading histogram Statistical graph obtained by processing the load cycles borne by the container using the cycle counting method.

Note. In the load histogram, the load cycle is represented by a rectangular block. The height and width of the block represent the load range and the number of cycles in the cycle respectively. When the loading history contains multiple cycles of different amplitudes, the load histogram consists of a series of blocks of different heights and widths. It is composed of parallel rectangular blocks.

3.1.2 Event The vessel design condition (UDS) may include one or more fatigue damage events, each of which consists of a number of time periods within a time period. The load components are specified at the intermediate points and are alternating at the specified times.

Note. An event can be a start, stop, accident state or any other cyclic action. The sequence of multiple events can be regular or random.

5 Elastic-plastic analysis methods

GB/T 4732.6-2024 Pressure vessel analysis and design Part